CLAIMS

What is claimed is:

1. A method, a sensor array that employs a parameter to induce a time-varying phase angle φ on an optical signal that comprises a phase generated carrier with a demodulation phase offset β, the method comprising the step of:

calculating the phase angle φ independently of the demodulation phase offset β.

2. The method of claim 1, further comprising the step of:

sampling an output signal from the sensor array to obtain a plurality of samples S_n, wherein $n = 0$ to x;

wherein the step of calculating the phase angle φ independently of the demodulation phase offset β comprises the step of:

calculating the phase angle φ independently of the demodulation phase offset β through employment of one or more of the plurality of samples S_n.

3. The method of claim 1, wherein the step of calculating the phase angle φ independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises the steps of:

calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β; and

calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

4. The method of claim 2, wherein the output signal comprises a period T_{pulse}, wherein the step of sampling the output signal from the sensor array to obtain the plurality of samples S_n, wherein $n = 0$ to x comprises the step of:

sampling the output signal from the sensor array to obtain a plurality of samples S_n within a period T_s, wherein $n = 0$ to x, wherein T_s is less than or equal to $1.125 \times T_{pulse}$.

5. The method of claim 4, wherein T_s is less than or equal to T_{pulse}.

6. The method of claim 4, wherein the step of calculating the phase angle φ independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises the steps of:

calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β;

calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

7. The method of claim 6, wherein the step of calculating the one or more quadrature terms and the one or more in-phase terms through employment of the one or more of the plurality of samples S_n, wherein the one or more of the one or more quadrature terms and the one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β comprises the steps of:

calculating a set of quadrature terms Q_j and a set of in-phase terms I_k through employment of one or more of the plurality of samples S_n, wherein $j = 0$ to y, wherein $k = 0$ to z;

calculating a quadrature term Q_{ab} from a largest term of absolute values of the set of quadrature terms Q_j;

calculating a constant C_1 and a constant C_2;

calculating a quadrature term $Q_s = C_1 \times \sqrt{\sum_{j=0}^{j=y} Q_j^2}$, wherein Q_s is substantially independent from the demodulation phase offset β; and

calculating an in-phase term $I_s = C_2 \times \sqrt{\sum_{k=0}^{k=z} I_k^2}$, wherein I_s is substantially independent from the demodulation phase offset β.

8. The method of claim 7, wherein the step of calculating the constant C_1 and the constant C_2 comprises the step of:

calculating the constant C_1 and the constant C_2 such that an amplitude of the quadrature term Q_s, an amplitude of the quadrature term Q_{ab}, and an amplitude of the in-phase term I_s comprise a substantially same amplitude for a modulation depth M of an operating range for the phase generated carrier.

9. The method of claim 7, wherein $x = 7$, $y = 3$, $z = 1$, wherein the step of calculating the set of quadrature terms Q_j and the set of in-phase terms I_k through employment of the one or more of the plurality of samples S_n, wherein $j = 0$ to y, wherein $k = 0$ to z comprises the steps of:

calculating $Q_0 = S_0 - S_4$;

calculating $Q_1 = S_1 - S_5$;

calculating $Q_2 = S_2 - S_6$;

calculating $Q_3 = S_3 - S_7$;

calculating $I_0 = (S_0 + S_4) - (S_2 + S_6)$; and

calculating $I_1 = (S_1 + S_5) - (S_3 + S_7)$.

10. The method of claim 7, wherein $x = 15$, $y = 7$, $z = 3$, wherein the step of calculating the set of quadrature terms Q_j and the set of in-phase terms I_k through employment of the one or more of the plurality of samples S_n, wherein $j = 0$ to y, wherein $k = 0$ to z comprises the steps of:

calculating $Q_0 = S_0 - S_8$;

calculating $Q_1 = S_1 - S_9$;

calculating $Q_2 = S_2 - S_{10}$;

calculating $Q_3 = S_3 - S_{11}$;

calculating $Q_4 = S_4 - S_{12}$;

calculating $Q_5 = S_5 - S_{13}$;

calculating $Q_6 = S_6 - S_{14}$;

calculating $Q_7 = S_7 - S_{15}$;

calculating $I_0 = (S_0 + S_8) - (S_4 + S_{12})$;

calculating $I_1 = (S_1 + S_9) - (S_5 + S_{13})$;

calculating $I_0 = (S_2 + S_{10}) - (S_6 + S_{14})$; and

calculating $I_1 = (S_3 + S_{11}) - (S_7 + S_{15})$.

11. The method of claim 7, wherein the step of calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms comprises the steps of:

calculating a correction term ΔQ;

calculating a quadrature term Q_m from the quadrature term Q_s and the correction term ΔQ;

calculating a quadrature term Q from a magnitude of the quadrature term Q_m and one or more quadrature terms of the set of quadrature terms Q_j;

calculating an in-phase term I from a magnitude of the in-phase term I_s and one or more in-phase terms of the set of in-phase terms I_k; and

calculating the phase angle φ from an arctangent of a quantity Q / I.

12. The method of claim 11, wherein the step of calculating the correction term ΔQ comprises the step of:

calculating the correction term $\Delta Q = Q_s - Q_{ab}$.

13. The method of claim 11, wherein the step of calculating the quadrature term Q_m from the quadrature terms Q_s and ΔQ comprises the step of:

calculating a constant C_3; and

calculating $Q_m = Q_s + (C_3 \times \Delta Q)$.

14. An apparatus, a sensor array that employs a parameter to induce a time-varying phase angle φ on an optical signal that comprises a phase generated carrier with a demodulation phase offset β, the apparatus comprising:

a processor component that calculates the phase angle φ independent from the demodulation phase offset β.

15. The apparatus of claim 14, wherein the processor component obtains a plurality of samples S_n of an output signal from the sensor array, wherein $n = 0$ to x;

wherein the processor component employs one or more of the plurality of samples S_n to calculate the phase angle φ independent from the demodulation phase offset β.

16. The apparatus of claim 15, wherein the processor component employs one or more of the plurality of samples S_n of the output signal to calculate one or more quadrature terms and one or more in-phase terms, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β of the phase generated carrier;

wherein the processor component employs the one or more quadrature terms and the one or more in-phase terms to calculate the phase angle φ.

17. The apparatus of claim 15, wherein the output signal comprises a period T_{pulse}, wherein the processor component obtains the plurality of samples S_n within a period T_s, wherein T_s is less than or equal to $1.125 \times T_{pulse}$.

18. The apparatus of claim 17, wherein T_s is less than or equal to T_{pulse}.

19. The apparatus of claim 17, wherein the processor component employs one or more of the plurality of samples S_n of the output signal to calculate one or more quadrature terms and one or more in-phase terms, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β of the phase generated carrier;

wherein the processor component employs the one or more quadrature terms and the one or more in-phase terms to calculate the phase angle φ.

20. The apparatus of claim 19, wherein the one or more of the one or more quadrature terms comprise a quadrature term Q_{ab} and a quadrature term Q_s, wherein the one or more of the one or more in-phase terms comprise an in-phase term I_s;

wherein the processor component employs one or more of the plurality of samples S_n, the quadrature term Q_{ab}, the quadrature term Q_s, and the in-phase term I_s to calculate the phase angle φ.

21. The apparatus of claim 20, wherein the processor component employs the plurality of samples S_n to calculate a set of quadrature terms Q_j and a set of in-phase terms I_k, wherein j = 0 to y, wherein k = 0 to z;

wherein the processor component employs the set of quadrature terms Q_j to calculate the quadrature term $Q_{ab} = \max(|Q_j|)$, wherein j = 0 to y;

wherein the processor component employs the set of quadrature terms Q_j and the set of in-phase terms I_k to calculate the quadrature term Q_s, and the in-phase term I_s.

22. The apparatus of claim 21, wherein the processor component calculates a constant C_1 and a constant C_2, wherein the processor component calculates:

$$Q_s = C_1 \times \sqrt{\sum_{j=0}^{j=y} Q_j^2};$$

wherein the processor component calculates:

$$I_s = C_2 \times \sqrt{\sum_{k=0}^{k=z} I_k^2};$$

wherein the processor component calculates the constant C_1 and the constant C_2 such that a magnitude of the quadrature term Q_s, a magnitude of the quadrature term Q_{ab}, and a magnitude of the in-phase term I_s comprise a substantially same magnitude at a modulation depth M of an operating range for the phase generated carrier.

23. The apparatus of claim 22, wherein the processor component employs the quadrature term Q_{ab} and the quadrature term Q_s to calculate a correction term $\Delta Q = Q_s - Q_{ab}$;

wherein the processor component employs the quadrature term Q_s and the correction term ΔQ to calculate a quadrature term Q_m;

wherein the processor component employs the quadrature term Q_m, the in-phase term I_s, the set of quadrature terms Q_j, and the set of in-phase terms I_k to calculate the phase angle φ.

24. The apparatus of claim 23, wherein the processor component employs the quadrature term Q_m and the set of quadrature terms Q_j to calculate a quadrature term Q, wherein the processor component employs the in-phase term I_s and the set of in-phase terms I_k to calculate an in-phase term I;

wherein the processor component calculates:

$Q = \pm Q_m$;

wherein the processor component calculates:

$I = \pm I_s$;

wherein the processor component employs the set of quadrature terms Q_j to determine a sign of Q;

wherein the processor component employs the set of in-phase terms I_k to determine a sign of I;

wherein the processor component calculates:

$\varphi = \text{arctangent} (Q / I)$.

25. The apparatus of claim 24, wherein the processor component calculates a constant C_3, wherein the processor component calculates:

$$Q_m = Q_s + (C_3 \times \Delta Q).$$

26. The apparatus of claim 25, wherein $x = 7$, $y = 3$, and $z = 1$;

wherein the processor component calculates:

$Q_0 = S_0 - S_4$, $Q_1 = S_1 - S_5$, $Q_2 = S_2 - S_6$, and $Q_3 = S_3 - S_7$;

wherein the processor component calculates:

$I_0 = (S_0 + S_4) - (S_2 + S_6)$; and

$I_1 = (S_1 + S_5) - (S_3 + S_7)$.

27. The apparatus of claim 25, wherein $x = 15$, $y = 7$, and $z = 3$; wherein the processor component calculates:

$Q_0 = S_0 - S_8$, $Q_1 = S_1 - S_9$, $Q_2 = S_2 - S_{10}$, $Q_3 = S_3 - S_{11}$,

$Q_4 = S_4 - S_{12}$, $Q_5 = S_5 - S_{13}$, $Q_6 = S_6 - S_{14}$, and $Q_7 = S_7 - S_{15}$;

wherein the processor component calculates:

$I_0 = (S_0 + S_8) - (S_4 + S_{12})$, $I_1 = (S_1 + S_9) - (S_5 + S_{13})$,

$I_2 = (S_2 + S_{10}) - (S_6 + S_{14})$, and $I_3 = (S_3 + S_{11}) - (S_7 + S_{15})$.

28. An article, a sensor array that employs a parameter to induce a time-varying phase angle φ on an optical signal that comprises a phase generated carrier with a demodulation phase offset β, the article comprising:

one or more computer-readable signal-bearing media;

means in the one or more media for calculating the phase angle φ independently of the demodulation phase offset β.

29. The article of claim 28, further comprising:

means in the one or more media for sampling an output signal from the sensor array to obtain a plurality of samples S_n, wherein $n = 0$ to x;

wherein the means in the one or more media for calculating the phase angle φ independently of the demodulation phase offset β comprises:

means in the one or more media for calculating the phase angle φ independently of the demodulation phase offset β through employment of one or more of the plurality of samples S_n.

30. The article of claim 29, wherein the means in the one or more media for calculating the phase angle φ independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises:

means in the one or more media for calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β; and

means in the one or more media for calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

31. The article of claim 29, wherein the output signal comprises a period T_{pulse}, wherein the means in the one or more media for sampling the output signal from the sensor array to obtain the plurality of samples S_n, wherein $n = 0$ to x comprises:

means in the one or more media for sampling the output signal from the sensor array to obtain the plurality of samples S_n within a period T_s, wherein $n = 0$ to x , wherein T_s is less than or equal to $1.125 \times T_{pulse}$.

32. The article of claim 31, wherein T_s is less than or equal to T_{pulse}.

33. The article of claim 31, wherein the means in the one or more media for calculating the phase angle φ independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises:

means in the one or more media for calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β;

means in the one or more media for calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

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